PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Lubricating Mechanism for the Intermediate or Translational Bearings of Contra-Rotating Airscrews

We, THE DE HAVILAND AIRCRAFT COMPANY LIMITED, a British Company, of Hatfield, Hertfordshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The lubricating mechanism forming the subject of the present invention has been designed for the purpose of lubricating the intermediate or translational bearings of contra-rotating airscrews for use on aircraft, the bearing in question consisting of a ball or other suitable anti-friction bearing located between the two airscrews and being associated with the hydraulic or other pitch change mechanism. In this connection it has previously been proposed to provide a reservoir for oil lubricant in proximity to the bearing into which reservoir excess oil from the bearing was drained under the action of centrifugal force when the airscrews reached a predetermined speed leaving a small predetermined quantity of oil in the bearing. On the rotational speed of the airscrews being reduced below the above predetermined speed or stopped oil was injected into the bearing by means of a series of spring urged plunger pumps which were previously maintained inoperative by centrifugal force.

The bearing is subjected to considerable stress during flight and one of the objects of the present invention is to provide an improved lubricating mechanism which will maintain the bearing in a cool state heat being removed from the bearing by a continuous circulation of oil through the bearing whilst the airscrews are rotating above a predetermined speed.

Lubricating mechanism according to the present invention for an intermediate or translational bearing of contra-rotating airscrews comprises an oil pump adapted to be driven continuously by relative rotation of the two airscrews for circulating oil through the bearing an an oil reservoir in communication with said pump and said bearing for supplying oil to the pump and for receiving oil drained from the bearing, the supply of oil to the bearing being proportional to the speed of rotation of the airscrews.

In order that the invention may be clearly understood and readily carried into effect the invention is hereinafter described with reference to the accompanying drawings in which:

Figure 1 is a sectional view of a translational bearing and its associated lubricating mechanism according to the present invention:

Figure 2 is a section on the line 2—2 in Figure 1:

Figure 3 is a perspective view diagrammatically illustrating such a translational bearing interposed between contra-rotating airscrews:

Figures 4 and 5 are views partly in section illustrating a modified construction of lubricating mechanism:

Referring in the first case to the construction illustrated by Figures 1 to 3, Figure 3 diagrammatically illustrates the positioning of the translational bearing indicated generally by reference numeral 1 between contra-rotating airscrews 2 and 3.

Figures 2 and 3 illustrate the bearing in greater detail, the bearing proper 4 being of the ball or roller type and being contained by inner and outer parts 5 and 6 of a housing the parts carrying the inner and outer races and being in driving connection with the adjacent airscrews. The

part 6 forms a reservoir 7 for oil, the latter being drawn from the reservoir and supplied to the bearing under pressure by means of two pumps 8 (see Figure 1) of the intermeshing gear wheel type. The pumps have shaft connections 9 to multi-start worms 10 in driven connection with a worm wheel 11 carried by the inner part 5 so that the pumps are driven at a speed proportional to the speed of rotation of the airscrews.

The supply of oil to the pumps is controlled by centrifugally opened spring closed inlet valves 12, the oil passing from the reservoir by way of these valves into oil passageways 13 to the pumps and from the pumps by way of further passageways 14 to the bearing proper.

The return of the oil in the bearing to the reservoir is controlled by centrifugally opened spring closed drain valves 15, the oil passing from the bearing to the drain valves through passageways 16 and from the drain valves to the reservoir through further passageways 17. The reservoir is fitted with one or more breather valves 18 which are also spring closed and open under centrifugal force to connect the interior of the reservoir to atmosphere. A removable fitting plug 19 is also fitted for topping up the reservoir with lubricant from time to time.

The arrangement is such that the drain valves open at a lower speed than the inlet valves which control the flow of lubricant to the pumps. In this way although the bearing will be supplied with plenty of oil during normal operation on the engine slowing down the inlet valves will first close, the drain valves remaining open to drain excesss oil away from the bearing prior to stopping the engine. Mechanical sealing means is rendered unnecessary due to the fact that the drain and inlet valves are centrifugally controlled, the valves providing centrifugal sealing of the unit. Any oil which remains in the bearing housing after the drain valves have closed is prevented from leaking out of the unit by the provision of gutters 20 on the bearing housing, any excess oil settling on the bottom of the bearing cavity.

Referring now to Figures 4 and 5 of the drawings which illustrate a development of the previously proposed construction the inlet and drain valves have been dispensed with with the object of simplifying the construction as much as possible, the breather valves 18 opening under the action of centrifugal force being retained. In this case steps are taken to ensure adequate sealing of the oil in the bearing and in this arrangement oil is pumped to the bearing by pumps 8 one only of which is shown which pumps are driven at a speed proportional to the airscrews as they are in indirect driving connection therewith. Consequently the quantity of oil delivered to the bearing will be in direct proportion to the speed of rotation of the engine. As the engine slows down the flow of oil to the bearing will be reduced and to prevent oil remaining in the bearing escaping, as for example, when again starting up the engine inner and outer oil seals 21 and 22 are provided.

Oil passes from the pumps 8 to the bearing through passageways 23. The pumps in this arrangement are driven through a system of worm gearing 24, spur gears 25 and a driving externally toothed gear ring 26 associated with the inner part of the housing.

Oil is returned from the bearing to the reservoir by centrifugal force through passageways 27.

What we claim is:—

1. Lubricating mechanism for an intermediate or translational bearing of contra-rotating airscrews comprising an oil pump adapted to be driven continuously by relative rotation of the two airscrews for circulating oil through the bearing and an oil reservoir in communication with said pump and said bearing for supplying oil to the pump and for receiving oil drained from the bearing, the supply of oil to the bearing being proportional to the speed of rotation of the airscrews.

2. Lubricating mechanism as claimed in claim 1, including centrifugally controlled drain and inlet valves opening at predetermined speeds of rotation of the airscrews for the purpose of maintaining a circulation of oil through the bearing above a predetermined rotational speed of the airscrews.

3. Lubricating mechanism as claimed in claim 2, wherein the drain valves are so constructed and arranged as to come into operation at a speed lower than that at which the inlet valves function for the purpose of draining excess oil away from the bearing before the airscrews come to rest.

4. Lubricating mechanism as claimed in any of the preceding claims, wherein the oil reservoir is fitted with one or more centrifugally operated breather valves which under the action of centrifugal force connect the interior of the reservoir with the atmosphere.

5. Lubricating mechanism as claimed in any of the preceding claims, wherein the bearing is located in a two part housing the parts being in driving connection with their respective airscrews and rotat-

able in opposite directions, the one part containing the oil reservoir and pump or pumps and the other part carrying a worm or other form of driving gear for driving the pump or pumps at an appropriate speed.

6. Lubricating mechanism as claimed in claim 5, wherein the driving mechanism includes intermeshing worm gears having a shaft connection with the pump or pumps, the latter being of the meshing gear wheel type located within that part of the housing forming the oil reservoir.

7. Lubricating mechanism as claimed in claim 5, wherein the pump or pumps of the meshing gear wheel type are driven through the medium of a system of spur gears and intermeshing worm and worm wheels.

8. Lubricating mechanism for an intermediate or translational bearing of contra-rotating airscrews substantially as hereinbefore described with reference to either of the examples illustrated in Figures 1 to 3 or 4 and 5 of the accompanying drawings.

Dated this 7th day of February, 1950.

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PROVISIONAL SPECIFICATION

Lubricating Mechanism for the Intermediate or Translational Bearings of Contra-Rotating Airscrews

We, THE DE HAVILAND AIRCRAFT COMPANY LIMITED, a British Company, of Hatfield, Hertfordshire, do hereby declare the nature of this invention to be as follows:—

The lubricating mechanism forming the subject of the present invention has been designed for the purpose of lubricating the intermediate or translational bearings of contra-rotating airscrews for use on aircraft, the bearing in question consisting of a ball or other suitable anti-friction bearing located between the two airscrews and being associated with the hydraulic or other pitch change mechanism. In this connection it has previously been proposed to provide a reservoid for oil lubricant in proximity to the bearing into which reservoir excess oil from the bearing was drained under the action of centrifugal force when the airscrews reached a predetermined speed leaving a small predetermined quantity of oil in the bearing. On the rotational speed of the airscrews being reduced below the above predetermined speed or stopped oil was injected into the bearing by means of a series of spring urged plunger pumps which were previously maintained inoperative by centrifugal force.

The bearing is subjected to considerable stress during flight, and one of the objects of the present invention is to provide an improved lubricating mechanism which will maintain the bearing in a cool state, heat being removed from the bearing by a continuous circulation of oil through the bearing whilst the airscrews are rotating above a predetermined speed. Lubricating mechanism in accordance with the present invention and for the purpose specified includes an oil pump driven continuously during rotation of the airscrews for supplying oil to the bearing from a reservoir, the flow of oil from the bearing to the reservoir and from the reservoir to the bearing being controlled by drain and inlet valves opening at predetermined speeds of rotation of the airscrews, oil being thereby maintained circulating through the bearing above a predetermined rotational speed of the airscrews.

It is preferred that the drain valves shall come into operation at a speed lower than that at which the inlet valves function, thereby draining excess oil away from the bearing prior to stopping the engine. Furthermore, the drain and inlet valves open under centrifugal action, the drain and inlet valves providing centrifugal sealing of the unit and avoiding the necessity for the provision of mechanical sealing means, the unit being drained prior to stopping the engine. Any oil which remains in the bearing housing after the drain valves have closed is prevented from leaking out of the unit by the provision of gutters on the bearing housing, any excess oil settling in the bottom of the bearing cavity.

In a preferred embodiment of the invention the unit takes the form of an alloy casting in driving connection with one of the airscrews, for example, the rear airscrew, which casting rotates relatively to a coaxially arranged worm gear which may either be stationary or alternatively be driven by the second contra-rotating airscrew. The casting is cored to provide an oil reservoir and carries one or more gear type oil pumps which are driven from the worm gear by multi-start worms,

it being preferred to utilise two such pumps arranged on opposite sides of the axis of rotation of the airscrews to form a balanced arrangement. The two pumps pump oil to a bearing housing containing the ball or other type of translational bearing, the flow of oil to the pumps from the reservoir being controlled by means of suitably positioned centrifugally opened spring closed inlet valves which rotate with the casting and are consequently acted upon by centrifugal force. Drainage of oil from the bearing housing to the reservoir takes place via suitably positioned drain valves which are opened as a result of centrifugal force and closed by means of associated springs. The arrangement is preferably such that above a certain airscrew speed oil will circulate continuously through the bearing, thus maintaining it in a cool condition, the inlet and drain valves opening at predetermined airscrew speeds. It is preferred that the drain valves shall open at a speed lower than that at which the inlet valves open, for example, at approximately one hundred revolutions below inlet valve opening speed corresponding to idling speed of the engine, so that as the airscrews decelerate the supply of oil to the pumps will be cut off first, any oil remaining in the circuit passing back to the reservoir via the drain valves.

As previously stated, gutters in the form of overhung lips on the bearing housing are provided to catch any oil which remains in the housing and prevent it leaking out of the unit.

With the arrangement hereinbefore described the translational bearing will be maintained cool by a continuous flow of oil when the airscrews are revolving at their normal speeds, when the stresses on the bearing are at a maximum, and when the rotational speed is low and the stresses correspondingly reduced the oil flow will be reduced and finally stopped on the speed of rotation falling below a certain minimum. By draining oil from the bearing housing prior to the engine being stopped, leakage of oil from the bearing housing will be prevented, a sufficient quantity of oil being left in the housing to give adequate lubrication to the bearing when the engine is again started up, but avoiding a surplus of oil in the bearing housing liable to be flung out by centrifugal force and deposited on the windscreen or other part of the aircraft under the action of the slipstream.

Dated this 7th day of January, 1949.
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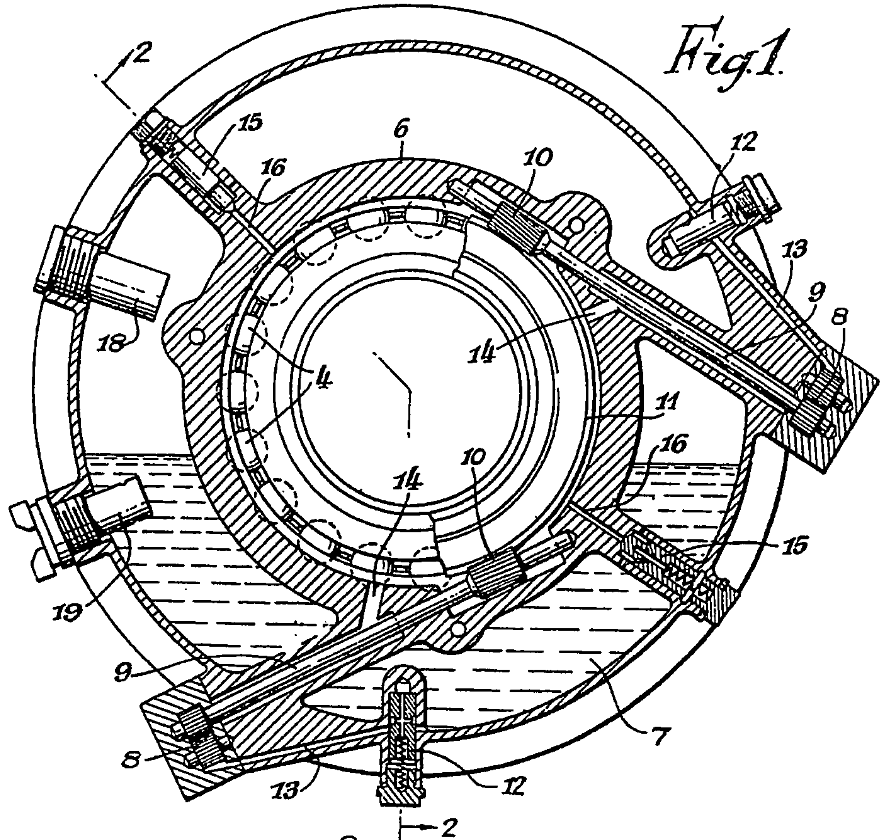

Fig.1.

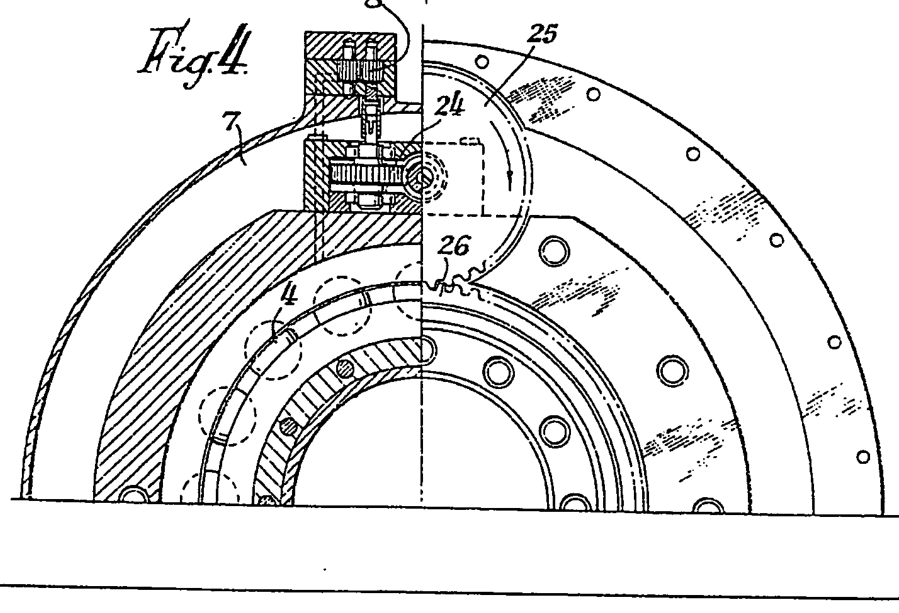

Fig.4.

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Fig.3.

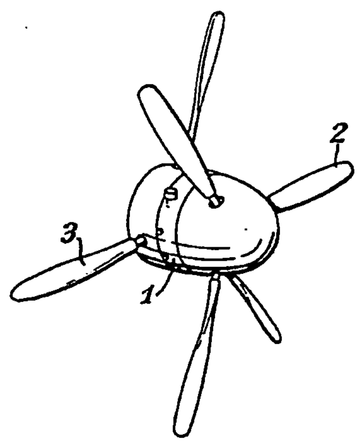
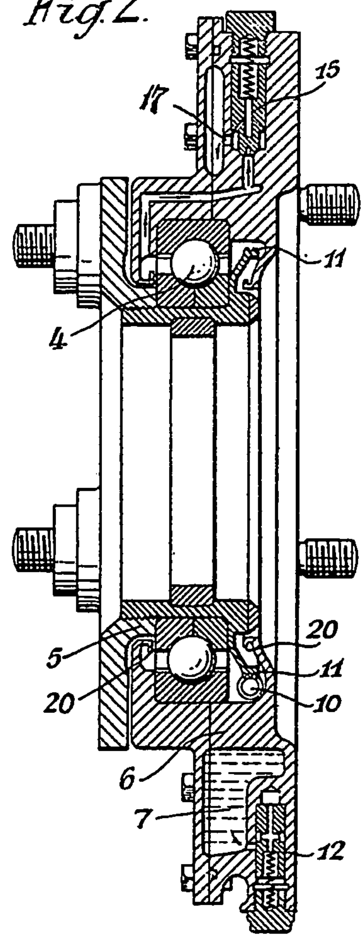


Fig.2.



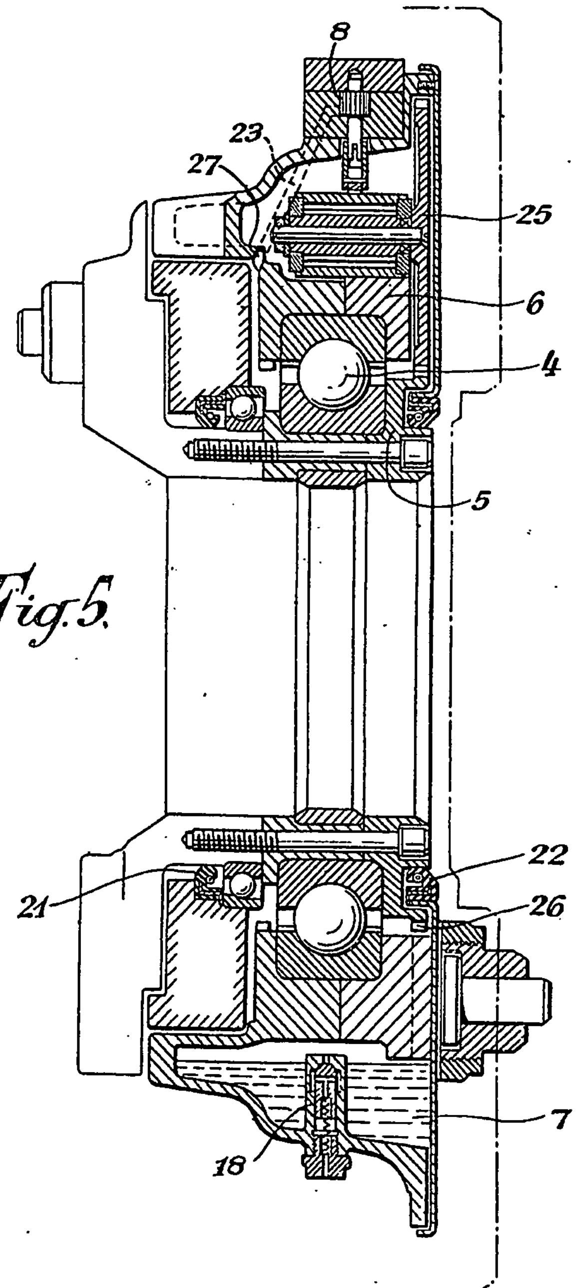


Fig.5.